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EFFECTS OF ORIGIN AND STORAGE METHOD ON THE GERMINATIVE CAPACITY OF PONDEROSA PINE SEED

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One of the most vexing problems in the management of ponderosa pine (Pinus ponderosa Laws.) is the difficulty of securing both natural and artificial regeneration in adequate amount. The problem is aggravated by the lack of periodicity of ample seed crops and it therefore becomes necessary to store seed to be used in artificial regeneration for varying lengths of time. While recent work (1) in pollen storage suggests that seed stored suitably may retain its viability indefinitely, practicability and economic necessity frequently dictate more convenient and conventional methods of storage.

OTHER INVESTIGATIONS

Several investigators have reported on the germination of ponderosa pine and other coniferous seed after different periods of storage (2, 3, 5) and have established useful facts to serve as guides in the handling of seed after collection and until the time of sowing. It has been shown that for ponderosa pine:

a. Stratification in moistened peat or sand will hasten and slightly improve germination of some seed lots.

b. Germination capacity can be as high as 87 percent after 11 to 20 years of storage at a constant temperature not exceeding 41° F.

c. Seed to be stored should be dried to 6- to 10-percent moisture content, oven-dry weight basis.

d. If stored in dry condition at close to a constant temperature of 40° F., seed can show higher germination than fresh seed from the same lot.

VARIABLES TESTED

This paper describes some effects of several methods of storage for 14 years on the germinative capacity of ponderosa pine seed, collected in central Idaho in 1936, from parent trees of different origin. Seed was stored in air-tight glass jars in the following locations:

a. Commercial cold storage at 32° F.

b. Commercial cold storage at 0° F.

c. A root cellar where the yearly temperature range is from about 30° to 60° F.

d. Underground (with the jars in a loose-covered metal container for protection) at a depth of 30 inches where the temperature range is from about 33° F. in winter to about 55° F. in summer.

e. In a loft where temperature range was substantial diurnally and annually, the latter from about -20° to 108° F.

Seed sources included:

a. Young (50 to 70 years) normal stand at 4,000 feet elevation.

b. Young normal stand at 5,500 feet elevation.

c. Young open stand at 4,000 feet elevation.

d. Young open stand at 5,500 feet elevation.

e. Scattered old (200 to 350 years) growth at 4,000 feet elevation.

f. Scattered old growth at 5,500 feet elevation.

The seed was sown in washed creek sand in wooden flats placed under shade outdoors and suitably protected from animals. A randomized block design[1/] was employed to permit an analysis of variance; in this design the position of the various origin-storage combination rows of 100 seed was randomly arranged within each of three blocks. The seed was planted on June 14 and 15, 1950, and counts of germination were made every 5 days until October 18. Since the viability values of the different lots of seed in 1936 were unknown, there was no opportunity to trace the deterioration in germinative capacity that might have occurred since collection.

[1/] The actual design was a modification of one by T. Ewald Maki, North Carolina State School of Forestry, who planned and initiated the experiment in 1937.

RESULTS AND CONCLUSIONS

Only fully emerged, normally developed seedlings were recorded as germinates; 53 percent of the total emergence was recorded by August 16. Interestingly enough, a total of 13 seed germinated in the spring following the year of test; this late germination shows that, under certain conditions at least, delayed germination occurs in this species.

The loft-stored seed showed no germination and was therefore excluded from the analysis. One jar of ground-stored seed had broken and zero germination necessitated supplying the missing values by the iterative method suggested by Snedecor (4) with appropriate adjustments in calculations. For purposes of analysis data were transformed to angles equal to the product of arc sin and the square root of the percentage. Actual average values for germinates are set forth in table 1.

Table 1. Average germinative capacity of ponderosa pine seed after 14 years of storage

Age, density, and elevation of parent stand	Storage methods				Average
	32° F.	0° F.	Root cellar	Under-ground	
	Percent of seeds sown				
Young, normal (4,000 ft.)	72.3	72.3	59.3	53.7	64.4
" " (5,500 ft.)	74.0	76.3	54.3	45.3	62.5
Young, open (4,000 ft.)	73.3	57.3	60.7	47.3	59.7
" " (5,500 ft.)	74.7	69.3	65.0	45.3	63.6
Old growth, scattered (4,000 ft.)	67.3	61.0	49.7	58.0	59.0
" " " (5,500 ft.)	57.3	56.7	44.7	47.7	51.6
Average	69.8	65.5	55.6	49.6	-

Analysis of variance revealed highly significant differences between origins and between storage methods; i.e., the probability of these differences being only chance ones is less than 1 in 100. There was also a significant value for interaction; i.e., the relationship of storage methods to the seed origins is unparallel and the likelihood of this being chance variation is less than 5 in 100.

To detect further the differences which analysis of variance indicated, "t" tests were made for pooled differences of means between storage methods, pooled differences in means between origins, and pooled differences in means for all storage-origin combinations.

These germination tests indicate that after 14 years the viability of ponderosa pine seed from central Idaho can be reduced to zero if storage has been under fluctuating temperatures where maxima reach 108° F.;

that regardless of whether collection is from young or old trees, the viability of seed may not deteriorate below an average of 44.7 percent if storage has been above ground or below ground (in air-tight containers) where annual temperatures range from approximately 30° to 50° F.; that regardless of age of parent trees the viability of seed may not fall below 56.7 percent if storage has been at constant temperatures of 32° or 0° F. They indicate further that 32° and 0° F. storage were (highly) significantly superior to root cellar and to underground storage, but that neither 32° and 0° F. nor root cellar and underground storage methods were significantly dissimilar, and that only seed from scattered old growth (5,500 ft.) showed significant differences from the other five sources. The significance of interaction between origins and storage methods suggests that viability can be influenced by origin, depending on the storage method, and that this is most pronounced (statistically significant) for seed from the first four origins and for underground storage.

While no general conclusions can be drawn from this limited test, the results do suggest that ponderosa pine seed for use in artificial regeneration in central Idaho might best be collected from young stands, either open or normal, and stored at either 32° or 0° F., preferably the former.

LITERATURE CITED

(1) Bredemann, G., K. Garber, P. Harteck, and Kl. A. Suhr. (U. Hamburg)

1948. Die Temperaturabbangigkeit der Lebensdauer von Blutenpollen. I Naturwiss. 34(9): 279-280.

(2) Mirov, N. T.

1946. Viability of pine seed after prolonged cold storage. Jour. Forestry 44: 193-195.

(3) Schubert, G. H.

1952. Germination of various coniferous seeds. California Forest and Range Experiment Station, Forest Research Note No. 83. Mimeo. 7 pp.

(4) Snedecor, George W.

1946. Statistical methods. 4th Ed. Iowa State College Press, Ames, Iowa. 485 pp.

(5) U. S. Forest Service

1948. Woody-plant seed manual. U. S. Dept. Agr. Misc. Pub. No. 654. 416 pp., illus.